CLAIMS

1. A dye-sensitized photoelectric conversion apparatus, comprising a semiconductor layer comprising a photosensitizing dye, being constituted such that a charge carrier generated by allowing light to be incident in the photosensitizing dye can be drawn out through the semiconductor layer, wherein the semiconductor layer is formed by a plurality of regions having different energy levels from one another of a passage through which the charge carrier is transferred and comprises the regions in which the energy levels in the semiconductor layer are reduced stepwise and/or continuously in the direction of drawing the charge carrier out.

2. The dye-sensitized photoelectric conversion apparatus as set forth in Claim 1, wherein the semiconductor layer is formed by a plurality of layers having different minimum energy levels from one another of conduction band and the energy levels are reduced stepwise and/or continuously in the direction of drawing the charge carrier out.

3. The dye-sensitized photoelectric conversion apparatus as set forth in Claim 1, wherein the plurality of regions comprise a plurality of semiconductor materials in which constitutional elements are different from one another.

4. The dye-sensitized photoelectric conversion apparatus as set forth in Claim 1, wherein the plurality of regions comprise semiconductor materials comprising same constitutional elements with one another and ratios of the constitutional elements are changed stepwise and/or continuously in the direction of drawing the charge carrier out.

5. The dye-sensitized photoelectric conversion apparatus as set forth in Claim 1, wherein the plurality of regions comprise semiconductor materials which are of a same element composition and are of different dopants from one another.

6. The dye-sensitized photoelectric conversion apparatus as set forth in Claim 1, wherein the plurality of regions comprise materials in which a same dopant is doped in a semiconductor material having a same element composition and a concentration of the dopant is changed stepwise and/or continuously in the direction of drawing the charge carrier out.

7. The dye-sensitized photoelectric conversion apparatus as set forth in Claim 1, wherein the photosensitizing dye is adhered on a surface of the semiconductor layer or

impregnated inside the semiconductor layer.

8. The dye-sensitized photoelectric conversion apparatus as set forth in Claim 1, wherein, on the side to which the photosensitizing dye is adhered, an irregular contour is formed on a first semiconductor layer and, by joining the irregular contour with a second semiconductor layer, the semiconductor layer is constituted.

9. The dye-sensitized photoelectric conversion apparatus as set forth in Claim 1, wherein the semiconductor layer comprising the photosensitizing dye and an electrolyte layer are laminated one on the other between a pair of electrodes.

10. The dye-sensitized photoelectric conversion apparatus as set forth in Claim 1, being constituted as a dye-sensitized photochemical cell.

11. A method for producing a dye-sensitized photoelectric conversion apparatus which comprises a semiconductor layer comprising a photosensitizing dye and is constituted such that a charge carrier generated by allowing light to be incident in the photosensitizing dye can be drawn out through the semiconductor layer, comprising the steps of:

constituting the semiconductor layer by a plurality of

regions having different energy levels from one another of a passage through which the charge carrier is transferred; and

arranging the plurality of regions such that the energy levels are reduced stepwise and/or continuously in the direction of drawing the charge carrier out.

12. The method for producing a dye-sensitized photoelectric conversion apparatus as set forth in Claim 11, wherein the semiconductor layer is constituted by a plurality of layers having different minimum energy levels from one another of conduction band and the energy levels are reduced stepwise and/or continuously in the direction of drawing the charge carrier out.

13. The method for producing a dye-sensitized photoelectric conversion apparatus as set forth in Claim 11, wherein a plurality of semiconductor materials having different constitutional elements from one another are laminated one on the other.

14. The method for producing a dye-sensitized photoelectric conversion apparatus as set forth in Claim 13, wherein a thin film comprising the semiconductor material is formed by a sputtering method or a sol-gel method.

15. The method for producing a dye-sensitized photoelectric conversion apparatus as set forth in Claim 13, wherein a step comprising coating of a dispersion containing a superfine grain of a semiconductor material, evaporating of a dispersion medium, and sintering, melt-fusing or bonding of the superfine grain is repeatedly performed on the plurality of semiconductor materials.

16. The method for producing a dye-sensitized photoelectric conversion apparatus as set forth in Claim 11, wherein, when a step of doping a plurality of types of dopants in the semiconductor layer by means of an ion implantation is performed, a dopant having a larger effect in reducing the energy level is doped in an inner portion by using a larger acceleration voltage by means of the ion implantation.

17. The method for producing a dye-sensitized photoelectric conversion apparatus as set forth in Claim 11, wherein, when a step of doping a single type of dopant in the semiconductor layer by means of an ion implantation is performed, the ion implantation by a large acceleration voltage is performed with a high dosage while the ion implantation by a small acceleration voltage is performed with a low dosage.

18. The method for producing a dye-sensitized

photoelectric conversion apparatus as set forth in Claim 11, wherein, when a step of doping a single type of dopant in the semiconductor layer by means of an ion implantation is performed, a dopant concentration distribution is changed by a thermal diffusion after a dopant implantation.

19. The method for producing a dye-sensitized photoelectric conversion apparatus as set forth in Claim 11, wherein the energy level is changed by implanting an oxygen ion in the semiconductor layer.

20. The method for producing a dye-sensitized photoelectric conversion apparatus as set forth in Claim 11, wherein, when a step of doping a plurality of types of dopants by introducing a dopant-containing gas into an atmospheric gas while the semiconductor layer is being formed by a sputtering method is performed, such doping is performed in the order of from a dopant having a large effect in reducing the energy level to a dopant having a small effect in reducing the energy level.

21. The method for producing a dye-sensitized photoelectric conversion apparatus as set forth in Claim 11, wherein, when a step of doping a single type of dopant by introducing a dopant-containing gas into an atmospheric gas while the semiconductor layer is being formed by a sputtering

method is performed, a concentration of the dopant-containing gas is reduced.

22. The method for producing a dye-sensitized photoelectric conversion apparatus as set forth in Claim 11, wherein the photosensitizing dye is adhered on a surface of the semiconductor layer or impregnated inside the semiconductor layer.

23. The method for producing a dye-sensitized photoelectric conversion apparatus as set forth in Claim 11, wherein, on the side to which the photosensitizing dye is adhered, an irregular contour is formed on a first semiconductor layer and, by joining the irregular contour with a second semiconductor layer, the semiconductor layer is formed.

24. The dye-sensitized photoelectric conversion method, wherein the semiconductor layer comprising the photosensitizing dye and an electrolyte layer are laminated one on the other between a pair of electrodes.